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Periodic table Atomic properties of the
elements

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Atomic Properties of the Elements

National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce

Circ

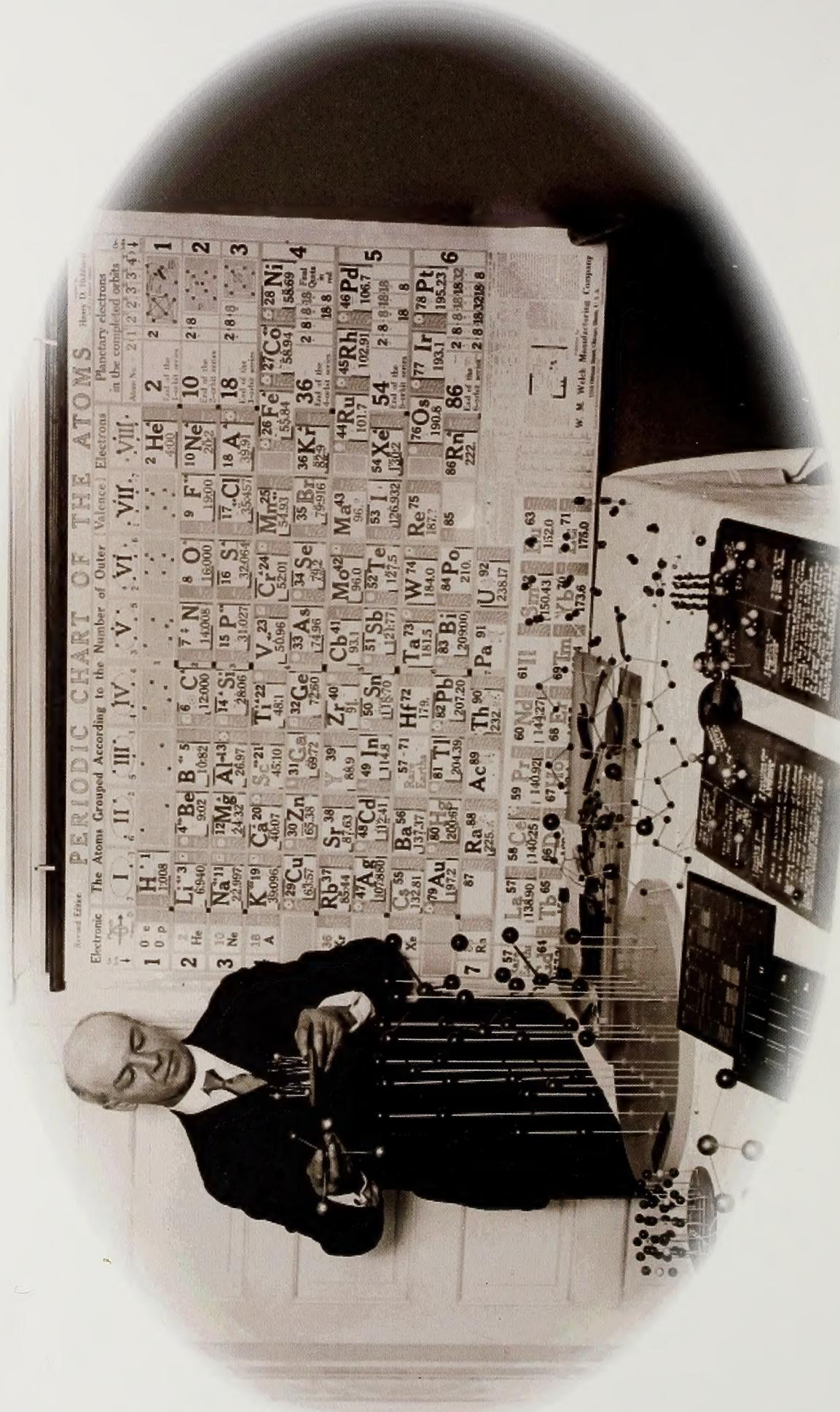
1
 S^2

[†]Based upon ¹²C. () indicates the mass number of the most stable isotope

| Period | | | | | | | | | | |
|--------|---|---------|---|-------------------|---|--|---|--|---|-----|
| 1 | H Hydrogen 1.00794 | 13.5984 | 1s | 2s _{1/2} | 2 | Li Lithium 6.941 1s ² 5.3917 | 4 | Be Beryllium 9.01218 1s ² 9.3227 | 3 | |
| 2 | Be Beryllium 9.01218 1s ² 9.3227 | 11 | Na Sodium 22.98977 [Ne]3s 5.1391 | 12 | Mg Magnesium 24.3050 [Ne]3s ² 7.6462 | 19 | K Potassium 39.0983 [Ar]4s 4.3407 | 20 | Ca Calcium 40.078 [Ar]4s ² 6.1132 | 21 |
| 3 | Mg Magnesium 24.3050 [Ne]3s ² 7.6462 | 37 | Rb Rubidium 85.4678 [Kr]5s 4.1771 | 38 | Sr Strontium 87.62 [Kr]5s ² 5.6949 | 39 | Y Yttrium 88.90585 [Kr]4f ⁵ s ² 6.2173 | 22 | Ti Titanium 47.867 [Ar]3d ² 6.8281 | 23 |
| 4 | Ti Titanium 47.867 [Ar]3d ² 6.8281 | 40 | Zr Zirconium 91.224 [Kr]4d ² s ² 6.6339 | 41 | Nb Niobium 92.90638 [Kr]4d ⁵ s 6.7589 | 24 | Cr Vanadium 50.9415 [Ar]3d ⁴ s ² 6.7462 | 25 | Mn Chromium 51.9961 [Ar]3d ⁵ s 6.7665 | 26 |
| 5 | Cr Chromium 51.9961 [Ar]3d ⁵ s 6.7665 | 42 | Mo Molybdenum 95.94 [Kr]4d ⁵ s ₅ 7.0924 | 43 | Tc Technetium (98) [Kr]4d ⁵ s ² 7.28 | 27 | Fe Iron 55.845 [Ar]3d ⁶ 4s ² 7.9024 | 28 | Co Cobalt 58.93320 [Ar]3d ⁷ 4s ₂ 7.8810 | 29 |
| 6 | Mo Molybdenum 95.94 [Kr]4d ⁵ s ₅ 7.0924 | 55 | Cs Cesium 132.90545 [Xe]6s 3.8939 | 56 | Ba Barium 137.327 [Xe]6s ² 5.2117 | 72 | Hf Hafnium 178.49 [Xe]4f ¹⁴ 5d ² 6s ² 6.8251 | 73 | Ta Tantalum 180.9479 [Xe]4f ¹⁴ 5d ³ 6s ² 7.5496 | 74 |
| 7 | Ba Barium 137.327 [Xe]6s ² 5.2117 | 87 | Fr Francium (223) [Rn]7s 4.0727 | 88 | Ra Radium (226) [Rn]7s ² 5.2784 | 104 | Rf Rutherfordium (261) [Rn]5f ¹⁴ 6d ² 7s ² 6.0? | 105 | Db Dubnium (262) | 106 |
| 8 | Rf Rutherfordium (261) [Rn]5f ¹⁴ 6d ² 7s ² 6.0? | 107 | Bh Bohrium (264) | 108 | Hs Hassium (269) | 109 | Mt Meitnerium (268) | 110 | Lu Lanthanum 138.9055 [Xe]5f ⁶ s ² 5.5769 | |
| 9 | Ce Cerium 140.116 [Xe]4f5d ⁶ s ² 5.5387 | 57 | La Lanthanum 140.116 [Xe]4f5d ⁶ s ² 5.5250 | 58 | Ce Cerium 140.116 [Xe]4f5d ⁶ s ² 5.473 | 59 | Pr Praseodymium 140.90765 [Xe]4f ⁷ 6s ² 5.473 | 60 | Nd Neodymium 144.24 [Xe]4f ⁹ 6s ² 5.5250 | 61 |
| 10 | Pr Praseodymium 140.90765 [Xe]4f ⁷ 6s ² 5.473 | 89 | Ac Actinium (227) [Rn]6d ⁷ s ² 5.17 | 90 | Th Thorium 232.0381 [Rn]6d ² 7s ² 6.3067 | 91 | Pa Protactinium 231.0388 [Rn]5f ² 6d ⁷ s ² 5.89 | 92 | U Uranium 238.0289 [Rn]5f ³ 6d ⁷ s ² 6.1941 | 93 |
| 11 | Pa Protactinium 231.0388 [Rn]5f ² 6d ⁷ s ² 5.89 | 94 | Pu Plutonium (244) [Rn]5f ⁶ 7s ² 6.0262 | 95 | Am Americium 243.0402 [Rn]5f ⁷ 6s ² 6.1941 | 96 | Cs Cesium 132.90545 [Xe]6s 3.8939 | 97 | Hg Mercury 200.5920 [Xe]6s ² 5.473 | 98 |
| 12 | Am Americium 243.0402 [Rn]5f ⁷ 6s ² 6.1941 | 99 | Tl Thallium 204.3833 [Xe]6s ² 5.473 | 100 | Pb Lead 207.2 [Xe]6s ² 5.473 | 101 | Bi Bismuth 208.9803 [Xe]6s ² 5.473 | 102 | Ra Radium 226.0259 [Rn]7s 4.0727 | 103 |
| 13 | Tl Thallium 204.3833 [Xe]6s ² 5.473 | 104 | Fr Francium (223) [Rn]7s 4.0727 | 105 | Ra Radium (226) [Rn]7s ² 5.2784 | 106 | Fr Francium (223) [Rn]7s 4.0727 | 107 | Fr Francium (223) [Rn]7s 4.0727 | 108 |
| 14 | Fr Francium (223) [Rn]7s 4.0727 | 109 | Fr Francium (223) [Rn]7s 4.0727 | 110 | Fr Francium (223) [Rn]7s 4.0727 | 111 | Fr Francium (223) [Rn]7s 4.0727 | 112 | Fr Francium (223) [Rn]7s 4.0727 | 113 |
| 15 | Fr Francium (223) [Rn]7s 4.0727 | 114 | Fr Francium (223) [Rn]7s 4.0727 | 115 | Fr Francium (223) [Rn]7s 4.0727 | 116 | Fr Francium (223) [Rn]7s 4.0727 | 117 | Fr Francium (223) [Rn]7s 4.0727 | 118 |
| 16 | Fr Francium (223) [Rn]7s 4.0727 | 119 | Fr Francium (223) [Rn]7s 4.0727 | 120 | Fr Francium (223) [Rn]7s 4.0727 | 121 | Fr Francium (223) [Rn]7s 4.0727 | 122 | Fr Francium (223) [Rn]7s 4.0727 | 123 |
| 17 | Fr Francium (223) [Rn]7s 4.0727 | 124 | Fr Francium (223) [Rn]7s 4.0727 | 125 | Fr Francium (223) [Rn]7s 4.0727 | 126 | Fr Francium (223) [Rn]7s 4.0727 | 127 | Fr Francium (223) [Rn]7s 4.0727 | 128 |
| 18 | Fr Francium (223) [Rn]7s 4.0727 | 129 | Fr Francium (223) [Rn]7s 4.0727 | 130 | Fr Francium (223) [Rn]7s 4.0727 | 131 | Fr Francium (223) [Rn]7s 4.0727 | 132 | Fr Francium (223) [Rn]7s 4.0727 | 133 |
| 19 | Fr Francium (223) [Rn]7s 4.0727 | 134 | Fr Francium (223) [Rn]7s 4.0727 | 135 | Fr Francium (223) [Rn]7s 4.0727 | 136 | Fr Francium (223) [Rn]7s 4.0727 | 137 | Fr Francium (223) [Rn]7s 4.0727 | 138 |
| 20 | Fr Francium (223) [Rn]7s 4.0727 | 139 | Fr Francium (223) [Rn]7s 4.0727 | 140 | Fr Francium (223) [Rn]7s 4.0727 | 141 | Fr Francium (223) [Rn]7s 4.0727 | 142 | Fr Francium (223) [Rn]7s 4.0727 | 143 |
| 21 | Fr Francium (223) [Rn]7s 4.0727 | 144 | Fr Francium (223) [Rn]7s 4.0727 | 145 | Fr Francium (223) [Rn]7s 4.0727 | 146 | Fr Francium (223) [Rn]7s 4.0727 | 147 | Fr Francium (223) [Rn]7s 4.0727 | 148 |
| 22 | Fr Francium (223) [Rn]7s 4.0727 | 149 | Fr Francium (223) [Rn]7s 4.0727 | 150 | Fr Francium (223) [Rn]7s 4.0727 | 151 | Fr Francium (223) [Rn]7s 4.0727 | 152 | Fr Francium (223) [Rn]7s 4.0727 | 153 |
| 23 | Fr Francium (223) [Rn]7s 4.0727 | 154 | Fr Francium (223) [Rn]7s 4.0727 | 155 | Fr Francium (223) [Rn]7s 4.0727 | 156 | Fr Francium (223) [Rn]7s 4.0727 | 157 | Fr Francium (223) [Rn]7s 4.0727 | 158 |
| 24 | Fr Francium (223) [Rn]7s 4.0727 | 159 | Fr Francium (223) [Rn]7s 4.0727 | 160 | Fr Francium (223) [Rn]7s 4.0727 | 161 | Fr Francium (223) [Rn]7s 4.0727 | 162 | Fr Francium (223) [Rn]7s 4.0727 | 163 |
| 25 | Fr Francium (223) [Rn]7s 4.0727 | 164 | Fr Francium (223) [Rn]7s 4.0727 | 165 | Fr Francium (223) [Rn]7s 4.0727 | 166 | Fr Francium (223) [Rn]7s 4.0727 | 167 | Fr Francium (223) [Rn]7s 4.0727 | 168 |
| 26 | Fr Francium (223) [Rn]7s 4.0727 | 169 | Fr Francium (223) [Rn]7s 4.0727 | 170 | Fr Francium (223) [Rn]7s 4.0727 | 171 | Fr Francium (223) [Rn]7s 4.0727 | 172 | Fr Francium (223) [Rn]7s 4.0727 | 173 |
| 27 | Fr Francium (223) [Rn]7s 4.0727 | 174 | Fr Francium (223) [Rn]7s 4.0727 | 175 | Fr Francium (223) [Rn]7s 4.0727 | 176 | Fr Francium (223) [Rn]7s 4.0727 | 177 | Fr Francium (223) [Rn]7s 4.0727 | 178 |
| 28 | Fr Francium (223) [Rn]7s 4.0727 | 179 | Fr Francium (223) [Rn]7s 4.0727 | 180 | Fr Francium (223) [Rn]7s 4.0727 | 181 | Fr Francium (223) [Rn]7s 4.0727 | 182 | Fr Francium (223) [Rn]7s 4.0727 | 183 |
| 29 | Fr Francium (223) [Rn]7s 4.0727 | 184 | Fr Francium (223) [Rn]7s 4.0727 | 185 | Fr Francium (223) [Rn]7s 4.0727 | 186 | Fr Francium (223) [Rn]7s 4.0727 | 187 | Fr Francium (223) [Rn]7s 4.0727 | 188 |
| 30 | Fr Francium (223) [Rn]7s 4.0727 | 189 | Fr Francium (223) [Rn]7s 4.0727 | 190 | Fr Francium (223) [Rn]7s 4.0727 | 191 | Fr Francium (223) [Rn]7s 4.0727 | 192 | Fr Francium (223) [Rn]7s 4.0727 | 193 |
| 31 | Fr Francium (223) [Rn]7s 4.0727 | 194 | Fr Francium (223) [Rn]7s 4.0727 | 195 | Fr Francium (223) [Rn]7s 4.0727 | 196 | Fr Francium (223) [Rn]7s 4.0727 | 197 | Fr Francium (223) [Rn]7s 4.0727 | 198 |
| 32 | Fr Francium (223) [Rn]7s 4.0727 | 199 | Fr Francium (223) [Rn]7s 4.0727 | 200 | Fr Francium (223) [Rn]7s 4.0727 | 201 | Fr Francium (223) [Rn]7s 4.0727 | 202 | Fr Francium (223) [Rn]7s 4.0727 | 203 |
| 33 | Fr Francium (223) [Rn]7s 4.0727 | 204 | Fr Francium (223) [Rn]7s 4.0727 | 205 | Fr Francium (223) [Rn]7s 4.0727 | 206 | Fr Francium (223) [Rn]7s 4.0727 | 207 | Fr Francium (223) [Rn]7s 4.0727 | 208 |
| 34 | Fr Francium (223) [Rn]7s 4.0727 | 209 | Fr Francium (223) [Rn]7s 4.0727 | 210 | Fr Francium (223) [Rn]7s 4.0727 | 211 | Fr Francium (223) [Rn]7s 4.0727 | 212 | Fr Francium (223) [Rn]7s 4.0727 | 213 |
| 35 | Fr Francium (223) [Rn]7s 4.0727 | 214 | Fr Francium (223) [Rn]7s 4.0727 | 215 | Fr Francium (223) [Rn]7s 4.0727 | 216 | Fr Francium (223) [Rn]7s 4.0727 | 217 | Fr Francium (223) [Rn]7s 4.0727 | 218 |
| 36 | Fr Francium (223) [Rn]7s 4.0727 | 219 | Fr Francium (223) [Rn]7s 4.0727 | 220 | Fr Francium (223) [Rn]7s 4.0727 | 221 | Fr Francium (223) [Rn]7s 4.0727 | 222 | Fr Francium (223) [Rn]7s 4.0727 | 223 |
| 37 | Fr Francium (223) [Rn]7s 4.0727 | 224 | Fr Francium (223) [Rn]7s 4.0727 | 225 | Fr Francium (223) [Rn]7s 4.0727 | 226 | Fr Francium (223) [Rn]7s 4.0727 | 227 | Fr Francium (223) [Rn]7s 4.0727 | 228 |
| 38 | Fr Francium (223) [Rn]7s 4.0727 | 229 | Fr Francium (223) [Rn]7s 4.0727 | 230 | Fr Francium (223) [Rn]7s 4.0727 | 231 | Fr Francium (223) [Rn]7s 4.0727 | 232 | Fr Francium (223) [Rn]7s 4.0727 | 233 |
| 39 | Fr Francium (223) [Rn]7s 4.0727 | 234 | Fr Francium (223) [Rn]7s 4.0727 | 235 | Fr Francium (223) [Rn]7s 4.0727 | 236 | Fr Francium (223) [Rn]7s 4.0727 | 237 | Fr Francium (223) [Rn]7s 4.0727 | 238 |
| 40 | Fr Francium (223) [Rn]7s 4.0727 | 239 | Fr Francium (223) [Rn]7s 4.0727 | 240 | Fr Francium (223) [Rn]7s 4.0727 | 241 | Fr Francium (223) [Rn]7s 4.0727 | 242 | Fr Francium (223) [Rn]7s 4.0727 | 243 |
| 41 | Fr Francium (223) [Rn]7s 4.0727 | 244 | Fr Francium (223) [Rn]7s 4.0727 | 245 | Fr Francium (223) [Rn]7s 4.0727 | 246 | Fr Francium (223) [Rn]7s 4.0727 | 247 | Fr Francium (223) [Rn]7s 4.0727 | 248 |
| 42 | Fr Francium (223) [Rn]7s 4.0727 | 249 | Fr Francium (223) [Rn]7s 4.0727 | 250 | Fr Francium (223) [Rn]7s 4.0727 | 251 | Fr Francium (223) [Rn]7s 4.0727 | 252 | Fr Francium (223) [Rn]7s 4.0727 | 253 |
| 43 | Fr Francium (223) [Rn]7s 4.0727 | 254 | Fr Francium (223) [Rn]7s 4.0727 | 255 | Fr Francium (223) [Rn]7s 4.0727 | 256 | Fr Francium (223) [Rn]7s 4.0727 | 257 | Fr Francium (223) [Rn]7s 4.0727 | 258 |
| 44 | Fr Francium (223) [Rn]7s 4.0727 | 259 | Fr Francium (223) [Rn]7s 4.0727 | 260 | Fr Francium (223) [Rn]7s 4.0727 | 261 | Fr Francium (223) [Rn]7s 4.0727 | 262 | Fr Francium (223) [Rn]7s 4.0727 | 263 |
| 45 | Fr Francium (223) [Rn]7s 4.0727 | 264 | Fr Francium (223) [Rn]7s 4.0727 | 265 | Fr Francium (223) [Rn]7s 4.0727 | 266 | Fr Francium (223) [Rn]7s 4.0727 | 267 | Fr Francium (223) [Rn]7s 4.0727 | 268 |
| 46 | Fr Francium (223) [Rn]7s 4.0727 | 269 | Fr Francium (223) [Rn]7s 4.0727 | 270 | Fr Francium (223) [Rn]7s 4.0727 | 271 | Fr Francium (223) [Rn]7s 4.0727 | 272 | Fr Francium (223) [Rn]7s 4.0727 | 273 |
| 47 | Fr Francium (223) [Rn]7s 4.0727 | 274 | Fr Francium (223) [Rn]7s 4.0727 | 275 | Fr Francium (223) [Rn]7s 4.0727 | 276 | Fr Francium (223) [Rn]7s 4.0727 | 277 | Fr Francium (223) [Rn]7s 4.0727 | 278 |
| 48 | Fr Francium (223) [Rn]7s<br | | | | | | | | | |

| Standard Reference Data Program | | | | | | | | | | | |
|---------------------------------|-------------------------|---------------------|--------|-------------------------|---------|-------------------------|-------------|-------------------------|---------|-------------------------|------------------|
| Physics Laboratory | | | | | | | | | | | |
| physics.nist.gov | | | | | | | | | | | |
| 2 | He | Helium | $1s^2$ | 4.00260 | | | | | | | |
| 5 | B | $^2P_1^o$ $1s^2$ | 6 | C | 3P_0 | 7 | $^4S_3/2$ | 8 | 3P_2 | 9 | $^2P_3/2$ |
| | Boron | | | Carbon | | Nitrogen | | Oxygen | | Fluorine | |
| | 10.811 | | | 12.0107 | | 14.00674 | | 15.9994 | | 18.99840 | |
| | $1s^2 2s^2 2p^1$ | | | $1s^2 2s^2 2p^2$ | | $1s^2 2s^2 2p^3$ | | $1s^2 2s^2 2p^4$ | | $1s^2 2s^2 2p^5$ | |
| | 8.2980 | | | 11.2603 | | 14.5341 | | 13.6181 | | 17.4228 | |
| 13 | Al | $^2P^o$ $1s^2$ | 14 | Si | 3P_0 | 15 | $^4S_3/2$ | 16 | 3P_2 | 17 | $^2P^o$ $3/2$ |
| | Aluminum | | | Silicon | | Phosphorus | | Sulfur | | Chlorine | |
| | 26.98154 | | | 28.0855 | | 30.97376 | | 32.066 | | 35.4527 | |
| | $[Ne]3s^2 3p^2$ | | | $[Ne]3s^2 3p^3$ | | $[Ne]3s^2 3p^4$ | | $[Ne]3s^2 3p^5$ | | $[Ne]3s^2 3p^6$ | |
| | 5.9858 | | | 8.1517 | | 10.4867 | | 10.3600 | | 12.9676 | |
| 31 | Ga | $^2P^o$ $1/2$ | 32 | Ge | 3P_0 | 33 | $^4S_{3/2}$ | 34 | 3P_2 | 35 | $^2P^o$ $3/2$ |
| | Gallium | | | Germanium | | Arsenic | | Selenium | | Bromine | |
| | 69.723 | | | 72.61 | | 74.92160 | | 78.993 | | 79.7930 | |
| | $[Ar]3d^{10} 4s^2 4p^2$ | | | $[Ar]3d^{10} 4s^2 4p^3$ | | $[Ar]3d^{10} 4s^2 4p^3$ | | $[Ar]3d^{10} 4s^2 4p^4$ | | $[Ar]3d^{10} 4s^2 4p^5$ | |
| | 5.9993 | | | 5.9993 | | 5.9993 | | 9.7524 | | 9.7524 | |
| 49 | In | $^2P^o$ $1/2$ | 50 | Sn | 3P_0 | 51 | $^4S_{3/2}$ | 52 | 3P_2 | 53 | $^2P^o$ $3/2$ |
| | Indium | | | Tin | | Antimony | | Tellurium | | Iodine | |
| | 114.818 | | | 118.710 | | 121.760 | | 127.60 | | Xenon | |
| | $[Kr]4d^{10} 5s^2 5p^2$ | | | $[Kr]4d^{10} 5s^2 5p^2$ | | $[Kr]4d^{10} 5s^2 5p^3$ | | $[Kr]4d^{10} 5s^2 5p^4$ | | $[Kr]4d^{10} 5s^2 5p^5$ | |
| | 5.7864 | | | 7.3439 | | 8.6084 | | 9.0096 | | 10.4513 | |
| 81 | Tl | $^2P^o$ $1/2$ | 82 | Pb | 3P_0 | 83 | $^4S_{3/2}$ | 84 | 3P_2 | 85 | $^2P^o$ $3/2$ |
| | Thallium | | | Lead | | Bismuth | | Polonium | | Astatine | |
| | 204.3833 | | | 207.2 | | 208.98038 | | (209) | | (210) | |
| | $[Hg]6p$ | | | $[Hg]6p^2$ | | $[Hg]6p^3$ | | $[Hg]6p^4$ | | $[Hg]6p^5$ | |
| | 6.1082 | | | 7.4167 | | 7.2855 | | 8.417? | | 10.7485 | |
| 114 | Uuo | | 116 | Uuh | | 118 | | Rn | | | |
| | Ununquadium | | | Ununhexium | | Ununoctium | | | | | |
| | (289) | | | (289) | | (293) | | | | | |

National Bureau of Standards / National Institute of Standards and Technology First Century of Service to the Nation, 1901 – 2001



The Hubbard Chart of the Atoms, ca. 1924

Henry D. Hubbard, the designer of the "Chart of the Atoms," was the first secretary of the National Bureau of Standards and served continuously in that capacity from 1901 until his retirement in 1938. Secretary Hubbard made a contribution to instruction in physics that is still in use today, his modernization of Mendeleev's periodic table. First constructed in the 1920's, it has been frequently revised and reprinted.



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